

**AMENDED SPECIFICATION**

Reprinted as amended in accordance with the Decision of the Superintending Examiner, acting for the Comptroller-General, dated the ninth day of April, 1942, under Section 21 of the Patents and Designs Acts, 1907 to 1942.

**PATENT SPECIFICATION**



Application Date: Feb. 26, 1936. No. 5789/36.

**464,877**

Complete Specification Left: Feb. 26, 1937.

Complete Specification Accepted: April 27, 1937.

**PROVISIONAL SPECIFICATION**

**Improvements in or relating to Rotary Pumps**

We, THE BRISTOL AEROPLANE COMPANY LIMITED, a British Company, and RALPH PONTING, a British Subject, both of Filton House, Bristol, in the County of Gloucester, do hereby declare the nature of this invention to be as follows:—

This invention is for improvements in or relating to rotary pumps of the kind comprising two or more stages of gear-wheel pumps connected together in series so that a pump at each stage delivers fluid into an inlet conduit of the pump of the succeeding stage and wherein, at each stage, the pump is of greater volumetric capacity than that at the succeeding stage so that the fluid-pressure is increased.

According to the present invention there is provided in a pump of the kind described, a loaded relief-valve in the conduit connecting the delivery of each stage to the inlet of the succeeding stage which valve is loaded to a pressure intermediate between the inlet pressure to one pump and the delivery pressure of the succeeding pump and is adapted to open automatically to permit the surplus fluid to escape to a drain.

According to another feature of the invention the relief-valve comprises means for adjusting the valve to open at any predetermined pressure in the inlet conduit so that the output pressure of the succeeding stage can be varied.

In a specific embodiment of the invention a high-pressure oil pump comprises four gear-wheel pumps mounted side-by-side. Each pump is of known construction and comprises two gear-wheels mounted to rotate in a housing which is provided with the usual chambers at the inlet and delivery side of the wheels. The pumps are separated from one another by spacing-discs and a conduit is formed in each disc joining the chamber on the delivery side of each pump with the cham-

ber on the inlet side of the succeeding pump. The discs and the pump-housings are bolted together face-to-face between end-plates so as to constitute a cylindrical casing.

A single driving shaft extends longitudinally of the casing and has all the driving gear-wheels keyed on to it and a second shaft extending longitudinally of the casing carries all the idler gear-wheels. These shafts are supported in bearings in the end-plates and suitable packing is provided at the points where they pass through the spacing-discs. All the gear-wheels are of the same diameter, but in each succeeding pump the wheels are of decreased axial length so that the volumetric capacity of each pump is only about 90% of the capacity of the preceding pump. It will be seen that as each pump delivers the fluid into the inlet conduit of the succeeding pump, each pump increases the pressure of the fluid.

In order to ensure that each pump is contributing the maximum possible increase in pressure without the necessity of having to design each pump so that it delivers exactly the required amount of fluid to the succeeding pump, the capacities of the pumps are chosen so that each pump will deliver an excess of fluid to the succeeding pump and by-passes are provided to return the surplus fluid from each pump to the inlet side of the first pumps.

The valves are situated in the delivery chambers in the pump-housings and are of the kind in which a ball is spring-pressed on to a seating. The pressure on the spring is adjustable by means of a set-screw so that the valve may be adjusted to open at any predetermined pressure which constitutes the inlet pressure for the succeeding pump.

It will be seen that by means of a care-

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ful setting of each valve, each pump is enabled to give the maximum increase in pressure, and if desired the controls for the various valves may be interconnected so as to maintain a suitable distribution of pressure between the various pumps.

Dated this 26th day of February, 1936.

BOULT, WADE & TENNANT,  
Chartered Patent Agents,  
111 & 112, Hatton Garden, London,  
E.C.1.

## COMPLETE SPECIFICATION (AMENDED).

### Improvements in or relating to Rotary Pumps

We, THE BRISTOL AEROPLANE COMPANY LIMITED, a British Company, and RALPH PONTING, a British Subject, both of Filton House, Bristol, in the County of Gloucester, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is for improvements in or relating to rotary pumps of the kind comprising two or more stages of gear-wheel pumps connected together in series so that a pump at each stage delivers liquid into an inlet conduit of the pump of the succeeding stage and wherein, at each stage, the pump is of greater volumetric capacity than that at the succeeding stage so that pressure is increased.

According to the present invention there is provided the combination with a pump of the kind described, of a loaded relief-valve in the conduit connecting the delivery from one stage to the inlet of the succeeding stage which valve is loaded to a pressure intermediate between the inlet pressure to first said stage and the delivery pressure of the succeeding stage and is adapted to open automatically to permit the surplus liquid to escape to a drain.

According to another feature of the invention a rotary pump comprises a plurality of gear pumps, spacing discs between said pumps, a conduit in each disc interconnecting the delivery of one pump and the inlet of the succeeding pump, and loaded relief valves communicating each with one of said conduits, said valves being adapted to open at a pressure intermediate between the inlet pressure of one pump and the delivery pressure of the succeeding pump, and all discharging to the inlet side of the first stage.

A specific embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is an end elevation of a pump according to the present invention;

Figure 2 is a plan;

Figure 3 is a section on the line 3—3 on Figure 2.

Figure 4 is a section on the line 4—4 on Figure 1; and

Figure 5 is a section on the line 5—5 on Figure 2.

As shown in the figures a high-pressure oil pump comprises four gear pumps mounted side-by-side. Each pump is of known construction and comprises gear-wheels 10 and 11 mounted to rotate in a housing 12, which is provided with the usual inlet and delivery chambers 14 and 15. The pumps are separated from one another by spacing-discs 16 and a conduit 17, joining the delivery-chamber 15 of each pump with the inlet chamber 14 of the succeeding pump, is formed in each disc. The discs 16 and the pump-housings 12 are held together between end-plates 18 and 19 by four bolts 20 so that they together constitute a cylindrical casing.

A driving shaft 21 extends longitudinally of the casing and has all the driving gear-wheels 10 keyed on to it, and a second shaft 22 carries all the idler gear-wheels 11. The shafts 21 and 22 are carried in bearings in the end-plates and suitable packing 23 is provided at the points where they pass through the spacing-discs. All the gear-wheels are of the same diameter, but in each succeeding pump the wheels are of decreased axial length so that the volumetric capacity of each pump is only about 90% of the capacity of the preceding pump. It will be seen that as each pump delivers the liquid into the conduit 17 leading to the succeeding pump, each pump increases the pressure of the liquid.

In order to ensure that each pump is contributing the maximum possible increase in pressure without the necessity of having to design it so that it delivers exactly the required amount of liquid to the succeeding pump, the capacity of each pump is chosen so that it will deliver an excess of liquid to the succeeding pump, and by-pass conduits 24 and a drain 25 are provided to return the surplus liquid from each pump to the inlet side of the first pump.

In each delivery-chamber 15 in the pump-housings, there is provided a valve 26 which comprises a ball 27 spring-

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pressed on to a seating 28. The pressure of the springs 29 on the bails 27 is adjustable by means of set-screws 30 so that each valve can be adjusted to open at any pre-determined pressure, which pressure constitutes the inlet pressure for the succeeding pump.

It will be seen that the by-passes not only allow an equitable distribution of pressure to be arrived at, but by suitable adjustment the final outlet pressure can be varied over a wide range.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. The combination with a pump of the kind described, of a loaded relief-valve in the conduit connecting the delivery from one stage to the inlet of the succeeding stage, which valve is loaded to a pressure intermediate between the inlet pressure to first said stage and the delivery pressure of the succeeding stage, and is adapted to

open automatically to permit the surplus liquid to escape to a drain.

2. A rotary pump comprising in combination, a plurality of gear-pumps, spacing-discs between said pumps, a conduit in each disc interconnecting the delivery of one pump and the inlet of the succeeding pump, and loaded relief-valves communicating each with one of said conduits said valves being adapted to open at a pressure intermediate between the inlet pressure of one pump and the delivery pressure of the succeeding pump, and all discharging to the inlet side of the first stage.

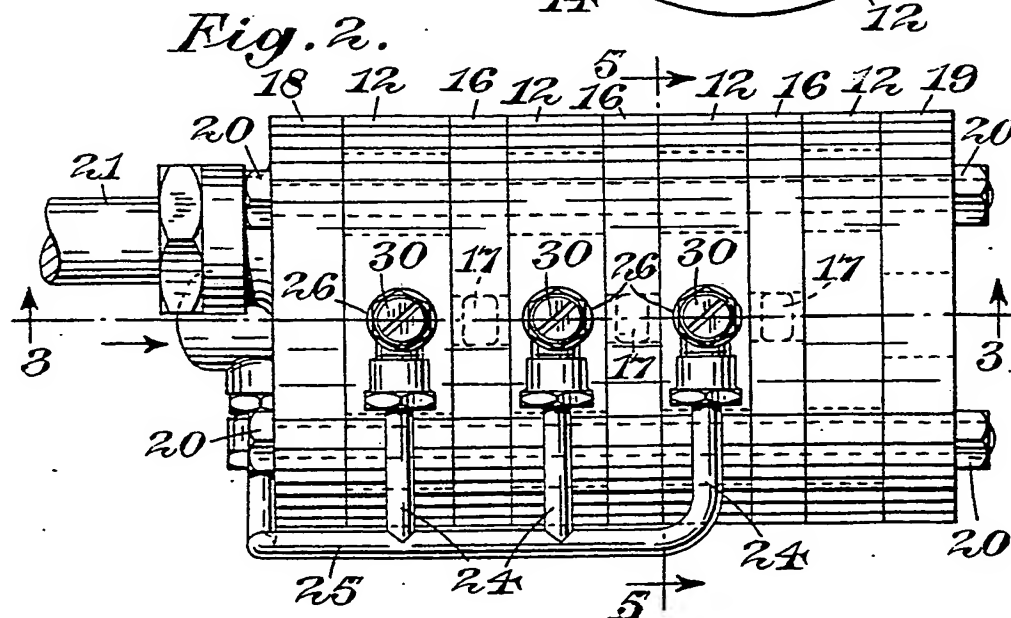
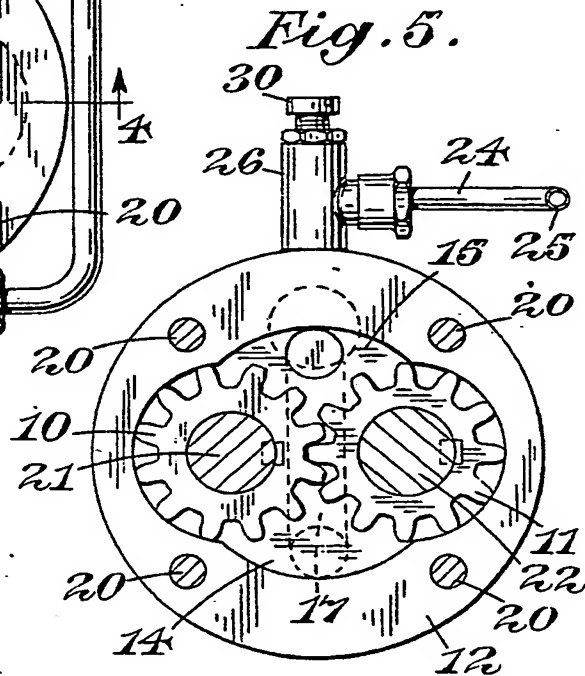
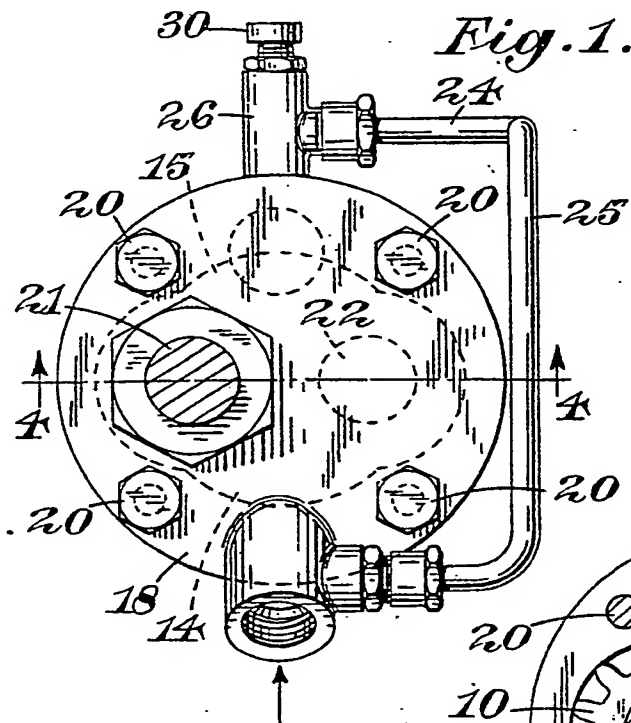
3. A rotary pump substantially as described with reference to the accompanying drawings.

Dated this 26th day of February, 1937.

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E.C.1.

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[This Drawing is a reproduction of the Original on a reduced scale.]



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Fig. 3.

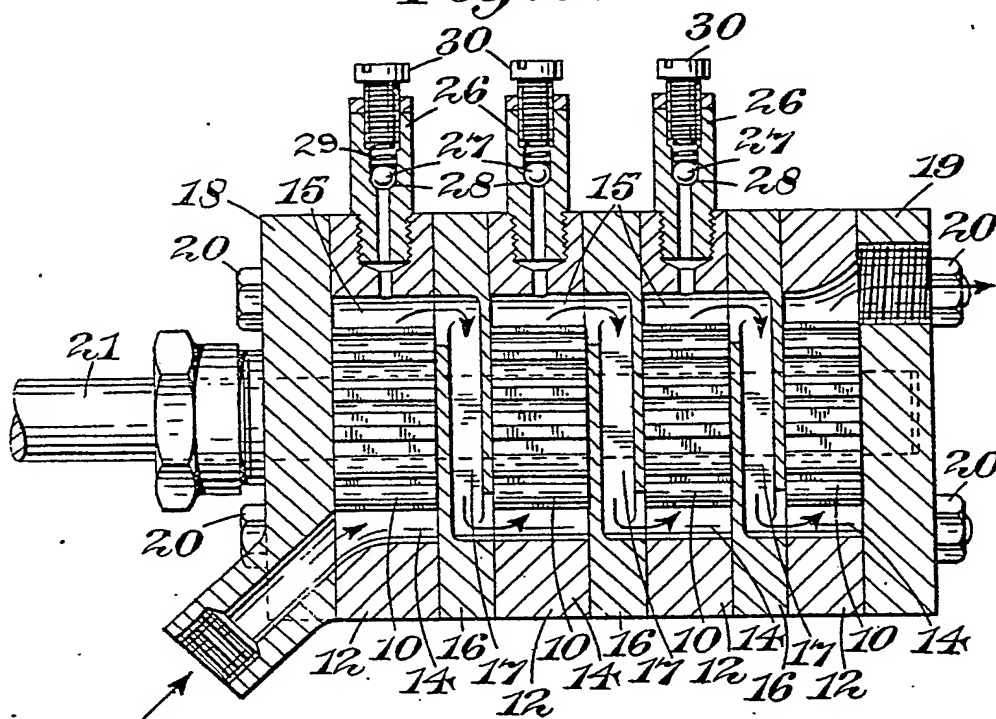
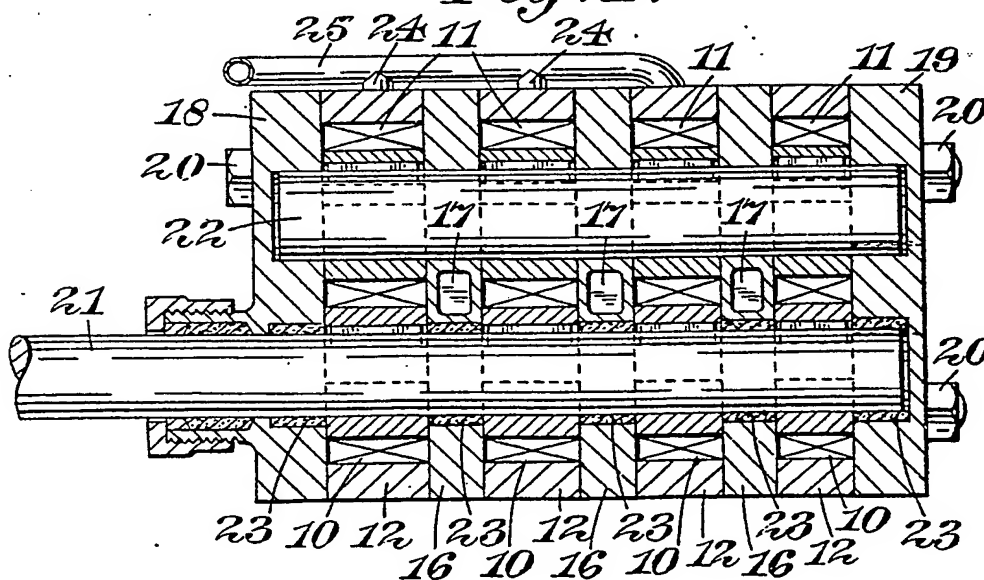


Fig. 4.



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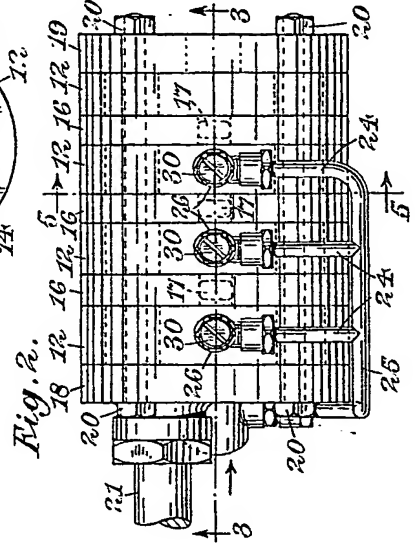
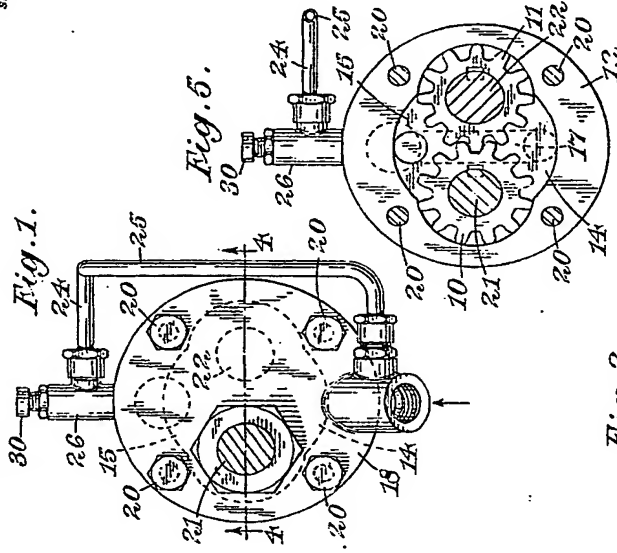


Fig. 3.

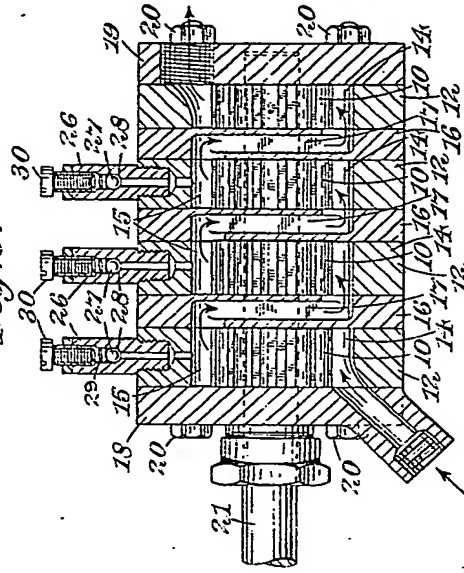
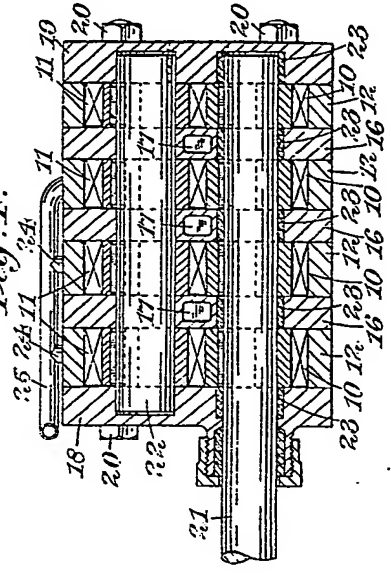


Fig. 4.



[This Drawing is a reproduction of the Original on a reduced scale.]